In the Specification

Replace the second paragraph on page 8 of the specification as presented in the preliminary amendment mailed October 2, 2002 as follows:

-- Fig. 4 is a schematic drawing of the last pixel element ~~storage well~~ in the CCD and its connection by way of a separate clocked output gate to the output differential amplifier by way of a floating diffusion node which is reset each clock cycle. For the active pixel architecture, $V\phi$ is the single pixel ~~storage~~ element connected to the output amplifier stage. --.

Replace the paragraph spanning pages 11, 12 and 13 as presented in the preliminary amendment mailed October 2, 2002 as follows:

-- The CCD described above has the unique capability of detecting an input signal in the spectral range from about 3μm to 20μm by the mechanism of intersubband absorption. The energy band diagram of the device is shown in Fig. 3. It shows the quantum well and the current flows of charge carriers which may either fill the well or empty the well. The current flows into the well are the thermal emission from the modulation doped layer 163 to the left of the well, and the generation currents flowing toward the well(s) from the collector depletion layer consisting of the layers 170, 171,156, and 157 and from the quantum well(s) and barrier(s) which are layers 159 and 160 respectively. The currents flowing out of the well are the thermal emission current from the quantum well into the modulation doped layer 163 and the photocurrent from the quantum well into the modulation doped layer produced by the intersubband absorption in the quantum well. The other important current flow is the recombination current Jrb which allows electrons to flow from the modulation doped layer to the emitter contact (metal gate electrode

120) via electron-hole recombination current in the capacitor layer 164. During the operation as a photodetector, the gate electrode 120 is forward biased with respect to the collector contact layer 170/collector electrode 170A. This means that the capacitor layer 164 is forward biased and the collector contact layer 170 is reverse biased which enables the photocurrent to be conducted out of the system by forward bias and the dark current current flow (Jrbd) in the system to be controlled by the reverse bias across the collector contact layer 170. The operation of the photodetector is described as follows. The quantum well is initially filled substantially in the absence of light. A reasonable design is that the Fermi energy is above the first subband in the quantum well. Then the absorption will be maximized because it is proportional to the number of electrons in the initial state. When long wavelength light is incident, then the photocurrent empties the quantum well. The dark current flowing into the well is produced by the generation current which is produced by emission across the energy gap of the quantum well or the barrier regions. The noise current i_n in ~~in~~ the device which represents the limit to the detectable power is specified by the dark current $\underline{I_d}$ ~~Id~~ and it is $\underline{i_n^2=2qI_dB}$ where q is the electronic charge and B is the bandwidth. In a conventional QWIP device, the dark current flows over a small barrier of a size comparable to the quantum well and therefore to obtain high background limited operation, it is necessary to cool the device to cryogenic temperatures of 50-60K in order to reduce $\underline{I_d}$ ~~Id~~. Only at these temperatures can the shot noise associated with the dark current be reduced to a level that is comparable to the noise associated with the black body radiation from the scene at a temperature of 300K. --.

Replace the first full paragraph on page 14 of the specification as presented in the preliminary amendment mailed October 2, 2002 as follows:

-- In both the CCD and the active pixel devices, the signal of interest is actually the the charge that is removed from the well. For very weak optical input signals, very little charge is removed and for very strong optical inputs the well is essentially emptied at the end of the imaging cycle. The situation is ideal for the elimination of noise in the detection process because it requires differential operation to obtain the actual output signal. For example, if the output of the imaged pixel is input to one side of a differential amplifier, then it is appropriate to input a signal to the other side of the DA from a full well to perform as a reference level. These connections are illustrated in Fig. 4 which shows a storage gate Vϕ (115), a transfer gate V_{dc} (115′), two ~~a~~ reset gates Vreset (115″, 115‴), a differential amplifier (DA) and two reference nodes, one for a full well ($V_{ref,full}$) and one for an empty well ($V_{ref,empty}$). This situation is identical to that used in the correlated double sampling scheme in advanced CCD read-out circuits to reduce set:reset noise. There are several noise mechanisms contributing noise to the amplifier inputs which include clocking noise, kTC noise on the reset transistor, and shot noise on the dark current to mention a few. All of the noise mechanisms that are common to the read-out of the cell with and without data, are reduced by the common mode rejection ratio of the differential amplifier. Therefore the intersubband detection within the inversion channel has a fundamental advantage because the differential process is essential to recover the signal, and yet at the same time, it performs the role of reducing many noise mechanisms according to the differential rejection of common mode signals. --.

Replace the third full paragraph on page 16 of the specification as presented in the preliminary amendment mailed October 2, 2002 as follows:

-- Every other pixel of the CCD may be biased ~~baised~~ to a constant voltage and the remaining pixels are clocked with a single phase clock pulse to produce 1 ½ phase operation. - -.